WPS5547

Policy Research Working Paper 5547

# Signaling and Technological Marketing Tools for Exporters

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January 2011

Policy Research Working Paper 5547


## Abstract

Besides superior productivity, what other firm characteristics are associated with export success? This empirical study identifies the effects of signaling tools (foreign technical license, International Standards Organization certification, and review of financial statements) and Internet tools (email and website) on export frequency and intensity of firms in developing countries. Using data from the World Bank's Enterprise Survey, the author finds that productivity, size, foreign ownership, International Standards Organization certification, and the use of Internet tools have positive effects on the probability of exporting and on the intensive margin of trade. International Standards Organization certified firms are 22 percent more likely to be exporters, whereas firms that use their own website to communicate with clients and suppliers increase the likelihood they export by 11 percent. Among exporting firms, those that are International Standards Organization certified sell 41 percent more abroad than firms that are not certified. Firms that use email sell 31 percent more in foreign markets than exporting firms that do not.


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This paper is a product of the Trade and Integration Team, Development Research Group. It is related to the Trade Costs and Facilitation Project with support of the Multi-Donor Trust Fund on Trade. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at eferro@brandeis.edu.

# Signaling and Technological Marketing Tools for Exporters

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[‡] The findings, interpretations, and conclusions expressed in this paper are entirely those of the author. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent. I thank Catherine L. Mann, John S. Wilson, Chad Bown, Rachel McCulloch, Daniel Lederman, an anonymous referee, and seminar participants at the International Business School at Brandeis University for ideas and comments through the preparation of this paper. This analysis is part of the Multi Donor Trust Fund on Trade project on Trade Costs and Facilitation at the World Bank.

## 1 Introduction

For consumers, the challenge of identifying the quality and reliability of goods prior to purchase can be problematic, particularly in international markets. Consumers rely on quality and efficiency signals to reduce search costs. I look at three of the signaling tools available to firms: obtaining a quality certification from the International Standards Organization (ISO), buying a technical license from a foreign firm, and having an external auditor review financial statements. I also analyze firms' use of email and/or a website to communicate with clients and suppliers. These technological tools work in the same way that signaling tools do—they directly reduce search costs for potential customers in foreign markets. These technologies make the firm more visible and accessible to potential customers located far away. The objective of this study is to identify how these tools affect the probability that a firm exports and amongst exporting firms how they affect the export intensity of these firms.

Using firm-level data from the World Bank's Enterprise Survey database, which covers more than 100 developing countries, I find that a firm that uses the Internet and/or is ISO certified is more likely to export; and among exporters, those that use these tools sell a higher percentage of total sales in foreign markets. ISO certification, in all specifications, is the best tool for firms. Firms that are ISO certified are 22% more likely to export and have 41% higher export intensity than those that are not certified. Firms that use their own website to communicate with clients and suppliers are 11% more likely to export whereas firms that use email sell 31% more abroad than firms that do not use email.

A growing body of empirical work has documented the superior productivity of exporting plants and firms relative to those producing solely for the domestic market. I argue that, besides this superior productivity, firms that sell in foreign markets are positively associated with firms that use signaling and technological marketing tools. I find some weak evidence that suggests that these tools might help firms become exporters; however, there is a need for panel data to be able to do a more comprehensive study of the direction of causality.

In the next section I discuss the existing literature that is relevant to the study of the impact of signaling and technological marketing tools on the export behavior of firms. In Section 3 I describe the data and the variables that are used in the empirical analysis. In Section 4 I confirm that the productivity premium between exporting and non-exporting firms exists in the sample of firms used in this study as it has been previously found in the literature. Section 5 describes the econometric framework and Section 6 explains the main results. Section 7 verifies the results from Section 6 through a number of robustness checks. Finally Section 8 summarizes the main findings and explains future work.

## 2 Literature Review

There are two main strands of literature that are relevant to the current study. First and foremost is the growing body of work related to the extensive margin in international trade. Of particular relevance are the empirical studies that document the superior performance characteristics of exporting plants and firms relative to non-exporters. According to this strand of literature, exporters are larger, more productive, more capital-intensive, and more technology-intensive than non-exporter firms. In addition, exporters

pay higher wages to their workers. A series of papers by Bernard and Jensen (1999, 2003, 2005), among others, find clear evidence that good firms become exporters.[1] They find that exporting firms display most of the desirable performance characteristics several years before they enter the export market. This evidence confirms the theory that there is a self-selection process of firms into exporting markets: only the most productive of firms can export due to the existing costs of entry into international markets. These entry costs might include expenses related to establishing a distribution channel, transport costs, or production costs to modify domestic models for foreign tastes. Although many of these extra costs have declined over time, and particularly rapidly in recent years, they still exist to a greater or lesser extent and provide an entry barrier that less successful firms cannot overcome. Thus, we can expect that, in a sample of non-exporting firms within the same industry, the larger, more productive firms should be more likely to become exporters. On the other hand, most empirical studies have found weak or no evidence that exporting increases the productivity of exporting firms, suggesting that the self selection process of firms into export markets dominates any effect of learning by exporting. Bernard and Jensen (1999) find that export status today is a poor predictor of future performance, especially over the long run.

The second strand of relevant literature is concerned with signaling and efficient market signals. Consumers in foreign and domestic markets face the problem of identifying the quality of goods prior to purchase. Customers rely on quality signals to reduce search costs. Many economic situations with asymmetric information can be modeled as signaling games. Spence (1973), for example, presents the very well-known model for the job market. In this model, workers with good information about their own

[1] Also see Aw et. al. (1995, 2000); Clerides et al. (1998); Roberts and Tybout (1997); Wagner (2007).

ability levels have to decide whether or not to obtain additional education. The employer cannot directly observe the marginal product of the job candidate prior to hiring. What he does observe is a plethora of personal data in the form of an individual's observable characteristics and attributes, including his education level. It is these characteristics that must ultimately determine an employer's assessment of the lottery he is buying. Knowing that education is more costly for low-ability workers, the employer observes the education signal—but not the worker's ability—prior to deciding on a wage offer.

Spence (1973) describes the main characteristics of an effective market signal. The signal has to convey a cost. Furthermore, in order for the signal to effectively from another, the cost of signaling needs to be negatively correlated with the productive capability. If these conditions fail to hold, everyone will invest in the signal in exactly the same way so that they cannot be distinguished on the basis of the signal.

Consumers use a wide range of signals to determine product quality, including price, brand name, advertisement expenditure, and friends' recommendations.[2] However, amongst these signals, country of origin is especially important for foreign products.[3] Perceptions of quality have become associated with the income per capita of the country of origin. Consumers recognize that the production of high-quality products requires a highly trained and educated workforce, which is found mostly in higher income countries. Thus, exporting firms from developing countries hoping to compete in the world market must persuade potential customers of the quality of their product. When the firm does not have an established presence in the world market, persuading customers can prove to be challenging—particularly because some of the signals of quality, such as

[2] For example, Cho and Kreps (1987); Milgrom and Roberts (1982, 1986).
[3] See Bilkey and Nes (1982).

brand name and word of mouth, relate to established products that are unavailable to these firms.

I look at three of the signaling tools available to firms: obtaining a quality certification from the International Standards Organization (ISO), buying a technical license from a foreign firm, and having an external auditor review financial statements. The existing literature has done little to explain the effect of technical licenses and external financial auditors on the exporting performance of a firm. However, there is a growing marketing and business management literature that looks at the effect of ISO certification. For example, King and Terlaak (2006) use an 11-year panel of U.S. manufacturing facilities to analyze whether or not ISO certification is a good signal for quality. [4] They hypothesize that ISO certification may provide a way of communicating about unobservable firm attributes, thereby generating a growth effect for ISO certified organizations. They find that ISO certified facilities grow faster and that this advantage does not result from changes in quality performance, inventory management, within-firm production allocation, or pre-certification growth differences but rather from a growth in demand. They also find that certification is particularly beneficial for organizations that operate in large and advertising intensive industries, industries where information search costs may be higher. Their study confirms that ISO certification could be used as an efficient signal of quality.

Besides signaling tools I also analyze how a firm's use of email and/or a website affects the firm's export behavior. These technological marketing tools reduce search costs for potential customers in foreign markets. Many studies that look in to the effect of

[4] Also see Heras et. al. (2002), Hallak and Sivadasan (2009), and Verhoogen (2008).

the Internet on trade either take a macro or a marketing-business approach which are usually based on small and localized business surveys.

Among the macro studies of the impact of the Internet on international trade, Freund and Weinhold (2004), for example, find that the use of the Internet stimulates trade. Evidence from time-series and cross-section regressions shows a significant effect of the Internet on trade in recent years. The results suggest that a 10 % increase in the growth of web hosts in a country leads to about a 0.2 % increase in export growth. For the average country in their sample, the Internet contributed to about a 1% increase in annual export growth from 1997 to 1999. Mann et al. (2004) quantify the effects of trade facilitation by considering four aspects of trade facilitation effort: ports, customs, regulations, and e-business. Based on a specific simulation design, the authors find that an improvement in their measure of e-business of the "below-average" countries "halfway" to the global average yields an increase in global trade of $154 billion. Ferro (2008) finds that a reduction in costs related to creating a website results in an increase in the proportion of firms that are able to export which in turn results in greater trade flows.

Marketing studies have also found positive effects of the Internet on trade. For example, Prasad et al. (2001) using survey data from a midwestern state in the U.S. find that firms' integration of Internet technology into marketing activities generally leverages the influence of market orientation on the firms' marketing competencies (compared with competitors), which in turn have a positive impact on their export performance. Daly and Miller (1998) present evidence from a 1998 survey of enterprises in 15 low and middle-income countries that suggests that firms in these countries use search engines to research

market opportunities. To the extent that these uses reduce the fixed costs of finding markets and buyers, Internet access might therefore increase exports.

## 3 Data and Variable Descriptions

I created a comprehensive dataset from the World Bank's Enterprise Survey data that includes all available information for manufacturing *firms* for all available countries and years. This results in a database of over 46,000 firms from surveys that took place between 2002 and 2008.[5] There are data from firms that belong to ten manufacturing sectors, in more than 100 developing countries, and five different regions of the world. Table 1 presents a breakdown of the data.

The World Bank's Enterprise Survey is intended to capture business perceptions of the biggest obstacles to enterprise growth, the relative importance of various constraints to increasing employment and productivity, and the effects of a country's business environment on its international competitiveness. This comprehensive survey collects data from key manufacturing and service sectors in every region of the world. It uses standardized survey instruments and a uniform sampling methodology to minimize measurement error and to yield data that are comparable across the world's economies. Enterprise Surveys use either simple random sampling or random stratified sampling. The first rounds of surveys used a simple random sampling methodology whereas surveys done on or after 2006 use a stratified sampling methodology. Surveys that use the stratified sampling methodology use three levels of stratification: industry, establishment size, and region. Under stratified random sampling unweighted estimates are biased

[5] There are over 46,000 observations from surveys in 106 different developing countries. However, there is many missing data. Missing data vary depending on which questions the firms were able and willing to answer. The sample of firms in the regressions that follow varies depending on the data that is available. The more variables that are used, the smaller the sample becomes.

unless sample sizes are proportional to the size of each stratum.[6] With stratification the probability of selection of each unit is, in general, not the same. Consequently, individual observations are weighted by the inverse of their probability of selection which is equivalent to the weighted average of the estimates for each stratum, with weights equal to the population shares of each stratum.

I classify the data available in this dataset into four groups of variables that are relevant to my estimation procedure. The first group consists of data needed in the estimation of the productivity of each firm. This includes output data given by total sales and inputs (labor, capital, and materials). Labor input is defined as the total labor cost, which includes wages, salaries, bonuses, etc. Capital input is given by the net book value of machinery, vehicles, and equipment. Cost of materials is defined as the cost of raw materials and intermediate goods used in production. With these data it is possible to estimate the value added of the firm and other measures of productivity. It is also possible to identify which firms are exporters as there is information on the proportion of total sales that are sold in foreign markets.

The optimal way to measure each firm's productivity would be to use methods such as those introduced by Olley and Pakes (1996) and Levinsohn and Petrin (2003) to estimate total factor productivity (TFP); however, these procedures cannot be applied as there is no time dimension in the data. As an alternative, I approximate TFP using Head

[6] All regression that follow in this study use the correct weights given by the sampling methodology. The dataset is described as a svyset (i.e., survey set) in Stata. Firms missing weight information as well as those that their data was collected using a simple random methodology where given a weight equal to one.

and Reis (2003) and Tomiura's (2007) definition of TFP for cross-sectional data.[7] ATFP is defined as

$$ATFP = \ln\frac{Y}{L} - s\ln\frac{K}{L}, \qquad (1)$$

Intuitively, this productivity measure starts with average labor productivity, Y/L, and adjusts for capital intensity K/L. Parameter *s* measures the importance of capital in the production function and can vary between zero and one. In the empirical implementation I follow Hall and Jones (1999) in setting the cost share of capital $s = 1/3$. This cost share of capital comes from the standard neoclassical approach, which is broadly consistent with national income accounts data for developed countries.

The drawback to ATFP is that it reflects both "true" technical efficiency as well as scale economies.[8] ATFP will be a good measure of technical efficiency if there are constant returns to scale and $s = 1/3$ is a reasonable measure of the cost share of capital. Even though the assumption of constant returns to scale seems to be a valid one, setting the cost share of capital of developing countries to be the same as for developed countries is worrisome.[9] Therefore, I will also use a lower cost share of capital in order to test the robustness of the results.

The second group of variables of interest from the Enterprise Survey includes firm characteristics that might influence a firm's output and productivity. In this category,

[7] I also estimate total factor productivity (TFP) using a constant returns to scale Cobb–Douglas specification of total output on capital, labor, and materials separately for each sector. I then calculate the firm-level residual using these sector coefficients. The residual is my firm-level measure of TFP. I use this measure of TFP on every regression that follows. Those results have been omitted as those measures of TFP are not robust. The results are not considerably different that the ones presented here. Results are available upon request.

[8] See Head and Reis (2003) for a more detailed explanation.

[9] I estimate a Cobb Douglas production function without restricting the coefficients to sum to one. The data reveals that constant returns to scale is not a bad assumption since the sum of the parameters for all three inputs range between 0.97 and 1.01 across sectors and the average of the sum equals 0.99. Results are available upon request.

I include the size of the firm as given by the number of permanent workers. I also include the age of the firm and whether there is a union established in the firm. I also take into account whether the firm provides formal training to its workers and whether the majority ownership is domestic, foreign, or public.

The third group includes the signaling tools that are available to firms. As mentioned in the literature review, a signal that can successfully identify the more qualified firms in addition to being costly must also be negatively correlated with the quality and productive capability of the firm. I believe that obtaining an ISO certification, securing a technology license from a foreign company, and/or hiring an external auditor to review and certify financial statements match the necessary criteria of an efficient signal.

As an example, the ISO family of standards represents an international consensus on good practices. According to the ISO, its primary aim is to provide firms with guidelines on what constitutes an effective quality system. These guidelines can then also serve as a framework for continuous improvement. While it is not a guarantee of quality per se, ISO certification means that an independent auditor has checked the process that influences quality. Firms will seek ISO accreditation if it is in their financial interests to do so, i.e., if the resulting increase in revenue is expected to exceed any net increase in costs. Net costs are the costs of accreditation less any savings the firm may make as a consequence of having better quality-control techniques in place. The increase in revenue comes about because quality is more effectively signaled and because there may be an actual increase in quality. The signaling benefit of ISO accreditation relies on customers' use of the signal. If the signal is efficiently used, then customers abroad will benefit,

particularly if the signal reduces search costs and obviates the need for purchasing firms to undertake their own quality control checks on supplier firms.

ISO certification is a perfect example of an effective signal. The first consideration is cost, which is likely to be significant for any firm seeking accreditation. Firms must invest time and effort to upgrade documentation, train employees, provide for gauge control, implement the quality management system, and hire an independent registrar to certify that they meet ISO standards. Each category has both internal and external costs. The time necessary to implement any changes also affects the cost. For example, Guler et al. (2002) document that obtaining ISO certification involves a considerable monetary investment (about $125,000) and time effort (about nine months to two years). These costs depend on internal compliance costs, which would tend to be higher for any firm that needs to go through extensive restructuring. Darnall and Edward (2006) find that ISO demands compliance with a wide range of quality system requirements, and that meeting these requirements are less costly for high quality organizations. Hutchins (1997) finds that high quality organizations need to undertake fewer adjustments and are more likely to be certified with the first visit of the auditor. Therefore, ISO certification also meets the second requirement for an effective market signal, that the cost of signaling needs to be negatively correlated with the quality and productive capability of the firm.

The same idea follows for the other two signaling variables. In the case of obtaining a technology license from a foreign company, the direct cost might be the same for any two firms, but the cost of integrating the new technology into the production process will tend to be higher for a less efficient and less productive firm. The cost of an

external auditor will also tend to be lower for the more efficient and organized firm since the auditor will have to spend less time organizing and revising financial documents.

The fourth and final group of variables includes the technological tools that firms can use in order to directly reduce search costs for potential customers. This group consists of two dummy variables for whether the firm uses email or its own website to communicate with clients and suppliers. These technology tools do not meet the criteria for an effective signal because the cost for using email or for creating a webpage will be the same whether or not the firm is efficient and produces a quality product. However, it works in the same way as an efficient signal; it reduces the search cost for potential new customers.

**4 Exporter Premia**

Before looking at the effect of signaling and technological tools on the exporting behavior of firms, I want to confirm that exporting firms in my sample match the characteristics identified by the previous literature. For this purpose, I follow Bernard and Jensen (1999) analysis to identify the exporter premium for different firm characteristics and measures of productivity.

I report the differences between exporters and non-exporters in Table 3 for the entire pool of data. The top panel of Table 3 reports the export premia estimated from a regression of the form

$$\ln X_i = \alpha + \beta Export_i + d_j + d_c + d_t + \varepsilon_i \qquad (2)$$

The bottom panel reports coefficients on an export dummy in a regression of the form

$$\ln X_i = \alpha + \beta Export_i + \delta Size + d_j + d_c + d_t + \varepsilon_i \qquad (3)$$

where $Export_i$ =1 if firm $i$ is an exporter. Sector, country, and year effects are controlled with $d_j$, $d_c$, and $d_t$, respectively. $X_i$ includes size, total sales per worker, value added per worker, average production wage, average non-production wage, capital per worker, and several measures of total factor productivity. In addition to all the control variables in equation (2), equation (3) takes into account the size of the firm as an explanatory variable for productivity. *Size* is defined as the total number of permanent full-time employees in the firm. The export premium, $\beta$, shows the average difference between exporters and non-exporters in the same sector, country, and year.

The export premia are positive and significant for every characteristic across both specifications. The largest difference between exporters and non-exporters is in their size. The top panel of Table 3 shows that exporters on average are 185% bigger than non-exporters.[10] The bottom panel of Table 3 shows exporters' productivity premia after controlling for their size. Labor productivity, measured by total sales per worker and value added per worker, is 34% and 37% higher for exporters; exporters on average have 22% higher capital per worker. Capital intensity does not explain all of the labor productivity differentials, as the two measures of total factor productivity are positive and significant. ATFP premia ranges between 30% and 40% depending on the capital intensity level used to estimate ATFP. Exporters pay higher non-production wages than non-exporters; however, they do not pay higher production wages.

Table 4 provides some evidence of the importance of signaling and technological marketing tools for the exporting behavior of firms. As mentioned earlier and as shown above, there is resilient evidence in the literature to support the theory that exporting

[10] The difference in percentage terms between exporters and non-exporters is calculated using Halvorsen and Palmquist (1980) method: 100*(exp(β)-1). This method will also be used in the interpretation of the results that follow.

involves a self-selection process, i.e., only the most productive firms are able to export. However, repeating the exercise presented in equation (3) and including an interaction term between the exporter dummy and the dummies for each signaling and technological tool, results in negative coefficients on these interaction terms. Specifically, I estimate

$$\ln X_i = \alpha + \beta_1 Export_i + \beta_2 Export_i * Tool + \upsilon Tool + \delta Size + d_j + d_c + d_t + \varepsilon_i \quad (4)$$

where *Tool* is a dummy for the five signaling and technological tools available to the firm and all other variables are defined as in equation (2) and (3). In this case, the mean productivity difference between exporters and non-exporters equals $\beta_1 + \beta_2$, given that the firms use the tool available to them (i.e., *Tool=1*). Since $\beta_2$ is negative and significant in most cases, this means that the productivity premium between exporting and non-exporting firms is smaller amongst those firms that, for example, have ISO certification, than the productivity premium between exporting and non-exporting firms that do not have ISO certification.

There are two possibilities of why this gap shrank in the presence of the tools. Either these tools are associated with higher productivity levels for non-exporters or these tools help less productive firms sell in foreign markets. This exercise hints at the idea that signaling and technological tools help firms sell in foreign markets either by increasing the productivity level of a firm to the level of exporters or by reducing the productivity threshold required in the self-selection process of firms into the world market.

**5 Econometric Framework**

In this section, I argue that, besides superior productivity, there are other tools available to firms that are essential for exporters' success in foreign markets. These tools reduce search costs for prospective customers and allow the firms using the tools to be more

accessible to buyers in foreign markets. In this section, I estimate the exporting behavior of firms given their productivity measure, firm characteristics, and use of signaling and technological tools.

Signaling and technology tools have the potential to help firms export in two different ways. First, a firm's use of these tools reduces search costs to potential customers. Second, firms that use these tools, particularly ISO certification and/or a foreign-owned technical license, can become more productive which, in turn, enables them to export. This is why it is important to control for the signaling and technology tools in the measures of productivity. With this in mind I estimate a two stage model where I use the first stage to isolate real productivity from any effect from the signaling and technological tools.

Take total sales per worker of firm *i*, belonging to sector *j* in country *c* and year *t* be:

$$y_i = A_i l_i^{\beta} k_i^{\delta} m_i^{\phi} \tag{4}$$

where $l_i$ is labor cost per worker (including wages, salaries, bonuses, etc.); $k_i$ is net book value of machinery, equipment, and vehicles per worker; and $m_i$ is the cost of raw and intermediate inputs per worker (I suppress sector, country, and year indexation for convenience). Assume that productivity $A_i$ is a function of firm characteristics, signaling tools, and technological tools.[11] In addition, assume that productivity depends on sector, country and time components:

$$\ln A_i = \gamma Z_i + \eta Q_i + \lambda T_i + \varepsilon_j + \varepsilon_c + \varepsilon_t + \varepsilon_i \tag{5}$$

[11] Moretti (2004) uses a similar framework to analyze education spillovers and firm productivity.

where $Z_i$ is a vector of firm characteristics, including size, age, and dummies indicating whether the firm provides training, whether it is unionized, and whether the majority owner of the firm is a domestic, foreign, or public entity. $Q_i$ is the vector of signaling tools. It consists of three dummy variables indicating whether the firm has acquired ISO certification, a technology license from a foreign firm, and/or an external financial auditor. $T_i$ is the vector of dummies indicating whether the firm uses email and/or its own webpage. ε's are unobserved productivity shocks at the firm, sector, country, and year level.

Equation (5) is the first step of a two step estimating process. In this first step I estimate the impact of signaling and technological tools on the productivity of the firm. The residual from the estimation of equation (5) is the measure of productivity for each firm in the second stage. This measure of total factor productivity is "pure" in the sense that it does not contain any potential effect of the signaling and technological tools on the productivity of the firm. Therefore in the second stage, where I regress the signaling and technological tools on the exporting behavior of firms, the coefficient of these variables will account for both their direct effect (i.e., the reduction of search costs to potential costumers) and their indirect effect (i.e., their impact on productivity). An issue arising with this estimation strategy is that the residual ATFP from equation (5) is a generated regressor for the second stage. Formally, the approach is a special case of the following general model presented by Pagan (1984):

$$y = \delta z^* + \gamma(z - z^*) + e \tag{6a}$$

$$z = z^* + \eta = \alpha W + \eta \tag{6b}$$

The expression $(z - z^*)$ represents that part of $z$ which is explained by factors other than

$W$ (i.e., the residual ATFP). Equation (6b) estimates the relationship between $W$ and $z$ such that $\alpha$ gives a measure of the strength of the link that exists between them. Pagan (1984) shows that the two-step procedure, of estimating residuals from (6b) and using them in (6a), gives asymptotically efficient estimates and the correct values for the standard errors. This implies that OLS gives us the correct estimates of variance as well as efficient coefficient estimates. This conclusion is independent of whether (6a) includes additional regressors or/and the latter appear in the matrix $W$. Hence, the use of residuals does not invalidate the inferences made and coefficient estimates are efficient.[12]

For the second stage, I use two different estimating procedures. I first look at the likelihood that a firm exports given its productivity, firm characteristics, and use of signaling and technology tools. I use a probit model in which $Export_i$, the dependent variable, is a dummy that equals one if the firm exports and zero if it does not. Let $\rho_{ij}$ be the probability that a firm exports, conditional on the observed variables, and specify the following probit equation:

$$\rho_i = \Pr(\text{Export}_i = 1 \mid \text{observed variables})$$

$$= \Phi(\sigma TFP_i + \gamma Z_i + \eta Q_i + \lambda T_i + d_j + d_c + d_t) \qquad (7)$$

where $\Phi(\cdot)$ is the cumulative distribution function of the unit-normal distribution, $TFP_i$ is the residual estimated from equation (5), and the other variables are defined as in equation (5).

I also use a second estimation procedure to analyze the impact of signaling and technological tools on the exporting behavior of firms. In this case the dependent variable is the *proportion* of sales that are sold in foreign markets. Because the dependent variable

[12] See also Wooldridge (2002), pp.141.

is censored between 0 and 100, I use a tobit model. Ordinary least squares estimates are biased and inconsistent. OLS yields a downwards-biased estimate of the slope coefficient and an upwards-biased estimate of the intercept.[13]

The tobit model assumes that $y = \beta X + \varepsilon$ is the latent regression model. $y$ represents continuous outcomes either observed or unobserved. Let $a$ be the lower censored limit, and let $b$ be the upper censored limit (i.e., a=0 and b=100). The tobit model can be expressed by the following relationship:

$$y_i^* = \begin{cases} y_i & if\ a < y_i < b \\ a & if\ y_i \le a \\ b & if\ y_i \ge b \end{cases}$$

I am interested in the change in the *conditional* expected value of the dependent variable (i.e., $\partial E(y_i^* \mid a < y_i^*) / \partial x_i$). This is the marginal effect of the observable variables, conditional on the firm being an exporter. I look at this conditional response because the use of signaling and technological tools might not only be associated with a higher likelihood of exporting but among exporters they could result in a higher exporting intensity.

**6 Results**

Table 5 shows the results from the first stage regression given by equation (5). All signaling and marketing tools have positive and significant coefficients which suggest that firms that use these tools have on average higher levels of productivity. The residuals from these regressions are the measures of productivity in the second stage. The second stage is the core of this study. It explores the correlation between signaling and

[13] Amemiya (1973) proved that the likelihood estimator from the Tobit model is consistent.

technological tools and exporting behavior, given the firm's characteristics and productivity. As mentioned above, I estimate a binomial probit model and a tobit model.

Table 6 shows the results from the probit model defined in equation (7). The dependent variable *Exporter* equals zero if the firm exclusively supplies the local market, and it equals one otherwise. There are five different specifications, all of which include sector, country, and year effects. Each column controls for an additional set of explanatory variables. Consistent with the existing literature, productivity, size, and type of ownership are significant in every specification. As expected the productivity and size of the firm are clear determinants for whether a firm exports or not. A 10% increase in productivity results in a 0.4% increase in the likelihood that the firm exports. The size of the firm has an even greater effect on its probability to export; a 10% increase in size results in 1.3% increase in the likelihood the firm exports. It is not surprising to find that the size of the firm has a greater impact in the likelihood that a firm exports considering that all firms in the sample are located in developing countries where economic activity is dominated by a mass of small and inefficient businesses, and perhaps as much as half the population works in the informal economy. In this scenario big firms are clearly more likely to export.

The type of ownership is also an important factor that determines the exporting behavior of a firm. Firms that are owned in their majority by a foreign entity are 13% more likely to export than national-private owned firms; whereas firms owned by a public entity are 16% less likely to export than national-private owned firms. The positive effect of foreign-ownership can be due to three main reasons: 1) network effects—foreign owners have connections in foreign countries; 2) supply chains—if the firm is a

subsidiary of a foreign company it is likely that the firm is part of a global supply chain; 3) productivity—foreign-owned firms are more productive and hence they are more likely to export.[14]

Amongst the variables of interest, only ISO certification and the technological marketing tools are consistently positive and significant across all specifications. Firms that have ISO certification are 22% more likely to be exporters than firms that are not ISO certified. There is a close relationship of firms that have ISO certification and those that are able to export and therefore ISO certification can provide an important avenue for policy implementation. Having a website, on the other hand, increases the likelihood that the firm exports by 11%, whereas the use of email increases the likelihood of exporting by 9%.[15] The significance and high coefficient on email is probably picking up on the effect of the firm having access to the Internet.

The Enterprise Survey also includes the percentage of total sales from exports for each firm. This variable allows for the exploration of the importance of signaling and technological tools in the export intensity of each firm. For easier interpretation I use *ln(1 + % total sales from exports)* as the dependent variable in the estimation of the tobit model. Table 7 presents the marginal effects conditional on the firm being an exporter. As with the probability of exporting, the productivity and size of the firm positively affect its export intensity. Foreign owned exporting firms sell 33% more in foreign

[14] See Ferro (2010) for a more detailed discussion of the impacts of foreign ownership on productivity.
[15] It is important to mention that out of the 17,535 firms that have their own website, 16,962 also use email, even though the correlation between the two variables is 0.57. Therefore, any positive marginal effect of using a website is in addition to that of using email. I tested for the inclusion of a variable that equals one if the firm uses both a website *and* email instead of the reported variable, which equals one if the firm uses its own website. The results do not differ.

markets than national owned exporting firms. Exporting firms with ISO certification have a 41% higher proportion of sales originating in foreign markets; whereas exporting firms that use email sell 31% more in foreign markets.

Even though not all signaling and technological tools are significant this study provides evidence that ISO certification and having access to the Internet not only increases the probability that a firm exports but also its export intensity. Firms that use these tools are more likely to export than firms that do not use them. Among firms that export, those using these tools sell a higher proportion of their total sales in foreign markets.

It is interesting that amongst the Internet marketing tools only the use of email is significant in both the probit and tobit models, whereas the use of a website to communicate with clients and suppliers is only significant in the probit model. Again, it is very likely that *email* is picking up the effect of whether the firm has access to the Internet. Having access to the Internet will not only affect the probability to export but also how much the firm can sell abroad. Furthermore, the results suggest that having a website works only as a signaling mechanism in the sense that a firm's website attracts foreign consumers; however, it has no effect on the export intensity.

## 7 Robustness Checks

### *7.1 ATFP vs. ATFP2*

As indicated in previous sections, ATFP is estimated using a cost share of capital of 1/3 which is consistent with income accounts data for developed countries. However, because the firms in this sample are located in developing countries the share cost of capital might be lower than in developed countries. The estimation of a constant return to

scale Cobb Douglas production function for the sample of firms in the Enterprise Survey suggests that that the cost share of capital is closer to $s = 1/10$.[16] Table 8 displays the results of the second stage probit and tobit regressions using the approximate measure of total factor productivity, ATFP2, estimated with a cost share of capital equal to 1/10.

The results using ATFP and ATFP2 are identical for the second stage. Both measures of productivity affect the probability a firm exports and its export intensity as well. Size, foreign ownership, ISO certification, and the use of email still remain positive and significant and the magnitudes on the coefficients for these variables are identical.

*7.2 Labor Productivity vs. ATFP*

There are frequent concerns of the quality of the data on capital and inputs from developing countries that is required to estimate ATFP and other productivity measures. To check that the results of Table 6 and Table 7 are not driven by measurement errors of these variables, I run the same regressions controlling for labor productivity (i.e., total sales per worker) instead of ATFP. Table 9 displays the results. Some of the coefficients slightly change in magnitude but overall results remain unchanged.

*7.3 One Stage vs. Two Stages*

In order to test that the results are not driven by the two-step specification, I include ATFP and not its residual in the estimation of the probit and tobit regressions. Table 10 displays the results. Even though the magnitude some of the variables of interest decrease in absolute terms, the results remain unchanged. An interesting finding from this set of regressions is that having a website is only significant in the probit regression whereas, using email is only significant in the tobit regression. This confirms previous results that

[16] If only labor and capital are used in the production function, excluding materials as an input, then the coefficients on capital are closer to 0.3.

having a website is an efficient signaling tool to attract foreign customers; however, it does nothing to improve sales among exporting firms.

## 8 Conclusions

All signaling and technological tools are significant factors for the productivity level of a firm. However, after controlling for productivity, only size, foreign ownership, ISO certification, and both Internet tools are positively associated with a greater likelihood that a firm exports. These factors were consistently statistically significant across all specifications. Among exporting firms, size, foreign ownership, ISO certification, and the use of email (Internet) were associated with higher export intensities. ISO certification, in all specifications, is the best performing tool, increasing the likelihood that a firm is an exporter by about 22% and increasing the proportion of sales in foreign markets by 41%. Having a website to communicate with clients and suppliers increases the likelihood the firm exports by 11%, and among exporters the use of email increases the proportion of foreign sales by around 31%. These results are robust to a number of different specifications and different control variables.

Public export-assistance programs have generally focused on educating firms as to the importance of exporting and providing key export market information (i.e., export market profiles, distributors, sales leads). The current study points to the additional need for these programs to encourage firms to embrace international certifications and the use of the Internet in leveraging their market orientation to realize superior marketing competencies and export performance. The importance of this task grows dramatically as more and more businesses in the international marketplace adopt both of these tools. Public policymakers can also encourage exporters to invest in these tools through a

variety of incentives and initiatives at a more macro level. These could entail, for example, tax breaks for Internet-related capital expenditures, tax breaks for ISO certified firms, and/or broadening the scope of exports facilitating financing activities by governmental agencies such as the Export-Import Bank or the Overseas Private In vestment Bank to cover capital expenditures necessary to obtain these tools by exporters and perhaps even their major customers abroad.

Clearly there is a close relationship of firms that have ISO certification and those that are able to export. This finding has important implications for possible export promotion programs and/or aid for trade. Particularly, ISO certification provides one of the few scenarios in trade related projects to implement natural random experiments. A natural random experiment is the optimal tool to measure the effectiveness of a program as it integrates a control and a treatment group from the design of a project and therefore makes it possible to pick up the causality and direct effect of such a project. Because of the public nature of trade projects, this methodology is usually not applicable; however, in this case it is. Certain firms can be assisted in obtaining this type of certification and others not allowing for a direct impact evaluation of such project.

Because I only have a cross-section of data, I cannot determine the direction of causality. I cannot determine if firms that have ISO certification and/or a website are the ones that are able to become exporters or if exporting firms are the ones that obtain these marketing and signaling tools. In Section 4 I provided some evidence that suggests the direction of tools helping firms become exporters as the exporter productivity premium is smaller among firms that use these tools; however, a more detailed study of causation is needed once panel data become available from the Enterprise Survey.

## References


Anderson, James and Douglas Marcouiller, 2002. “Insecurity and the Pattern of Trade: An Empirical Investigation.” Review of Economics and Statistics, 84(2), pp. 345-352.

Anderson, James and Eric van Wincoop, 2004. “Trade Costs.” Journal of Economic Literature, vol. 42, pp. 691-751.

Amemiya, Takeshi 1973. "Regression analysis when the dependent variable is truncated normal." Econometrica, vol 41(6), pp. 997–1016.

Arnold, Kenneth, 1994. “The Managers Guide to ISO 9000.” The Free Press: New York.

Aw, Bee Yan and Amy Hwang, 1995. “Productivity and the Export Market: A Firm-Level Analysis.” Journal of Development Economics, vol. 47, pp. 313-332.

Aw, Bee Yan, Sukkyun Chung and Mark Roberts, 2000. “Productivity and Turnover in the Export Market: Micro Evidence from Taiwan and South Korea.” The World Bank Economic Review.

Bernard, Andrew and J. Bradford Jensen, 1999. “Exceptional Exporter Performance: Cause, Effect, or Both?” Journal of International Economics, vol. 47, pp. 1-25.

Bernard, Andrew and J. Bradford Jensen, 2004. “Exporting and Productivity in the USA.” Oxford Review of Economic Policy, Oxford University Press, vol. 20(3), pp. 343-357.

Bernard, Andrew, Jonathan Eaton, J. Bradford Jensen, and Samuel Kortum, 2003. “Plants and Productivity in International Trade.” The American Economic Review, vol. 93(4), pp. 1268-1290.

Bilkey, Warren J. and Erik Nes, 1982. “Country-of-Origin Effects on Product Evaluations.” Journal of International Business Studies, vol. 13(1), pp. 89-99.

Cho, In-Koo and David Kreps, 1987. “Signaling Games and Stable Equilibria.” Quarterly Journal of Economics, vol. 102(2), pp. 179-222.

Daly, John and Robert R. Miller, 1998. “Corporations' Use of the Internet in Developing Countries.” Discussion Paper # 35, International Finance Company, Washington DC.

Darnall, Nicole and Daniel Edwards, 2006. “Predicting the Cost of Environmental Management System Adoption: The Role of Capabilities, Resources and Ownership Structure.” Strategic Management Journal, vol. 27(2), pp. 301-320.

Ferro, Esteban, 2008. “How Does Trade Facilitation Affect Trade Patterns?” Brandeis University, mimeo.

Ferro, Esteban, 2010. “Productivity in Globalized Firms.” Brandeis University, mimeo.

Freund, Caroline L. and Diana Weinhold, 2004. “The Effect of the Internet of International Trade.” Journal of International Economics, vol. 62(1), pp. 171-189.

Guler, Isin, Mauro F. Guillen, and John M. Macpherson, 2002. “Global Competition, Institutions, and the Diffusion of ISO 9000 Quality Certificates.” Administrative Science Quarterly, vol. 47, pp. 207-232.

Hallak, Juan Carlos and Jagadeesh Sivadasan, 2009. “Firms’ Exporting Behavior Under Quality Constraints.” NBER Working Papers 14928, National Bureau of Economic Research, Inc.

Halvorsen, Robert and Raymond Palmquist, 1980. “The Interpretation of Dummy Variables in Semilogarithmic Equations.” The American Economic Review, vol. 70(3), pp. 474-475.

Heras, Inaki, Gavin P. M. Dick, and Marti Casadesus, 2002. “ISO 9000 Registration's Impact on Sales and Profitability: A Longitudinal Analysis of Performance Before and After Accreditation.” International Journal of Quality & Reliability Management, vol. 19(6), pp. 774-791.

Hutchins, Greg, 1997. ISO 9000: A Comprehensive Guide to Registration, Audit Guidelines and Successful Certification. Wiley, New York.

ISO Central Secretariat, 2007. “The ISO Survey of Certifications 2007.” www.iso.org.

The International Study Group on Exports and Productivity, 2007. "Exports and Productivity – Comparable Evidence for 14 Countries," World Bank Policy Research Working Paper 4418.

King, Andrew A. and Ann Terlaak, (2006). “The Effect of Certification with the ISO 9000 Quality Management Standard: A Signaling Approach.” Journal of Economic Behavior & Organization, vol. 60, pp. 579-602.

Levinsohn, J. and A. Petrin, 2003. “Estimating Production Functions Using Inputs to Control for Unobservables.” Review of Economic Studies, vol. 70(2), pp. 317-342.

Mann, Catherine L., John Wilson and Tsunehiro Otsuki, 2004. “Assessing the Potential Benefit of Trade Facilitation: A Global Perspective.” World Bank Working Paper WPS 3224.

McKinsey Company Global Institute, 1993. “Manufacturing Productivity.” McKinsey and Company, Inc. Washington, DC.

Milgrom, Paul and John Roberts, 1982. “Limit Pricing and Entry under Incomplete Information: An Equilibrium Analysis.” Econometrica, vol. 50(2), pp. 443-460.

Milgrom, Paul and John Roberts, 1986. “Price and Advertising Signals of Product Quality.” The Journal of Political Economy, vol. 94(4), pp. 796-821.

Moretti, Enrico, 2004. “Workers' Education, Spillovers, and Productivity: Evidence from Plant-Level Production.” The American Economic Review, vol. 94(3), pp. 656-690.

Olley, G. S. and A. Pakes, 1996. “The Dynamics of Productivity in the Telecommunications Equipment Industry.” Econometrica, vol. 64, pp. 1263-1297.

Pagan, Adrain, 1984. “Econometric Issues in the Analysis of Regressions with Generated Regressors.” International Economic Review, vol. 25(1), pp. 221-247.

Prasad, V. Kanti, K. Ramamurthy, and G.M. Naidu, 2001. “The Influence of Internet-Marketing Integration on Marketing Competencies and Export Performance.” Journal of International Marketing, vol. 9(4), pp. 82-110.

Roberts, Mark J. and James R. Tybout, 1997. “The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs.” American Economic Review, vol. 87(4), pp. 545–564.

Spence, Michael, 1973. “Job Market Signaling.” The Quarterly Journal of Economics, vol. 87(3), pp. 355-374.

Verhoogen, Eric A., 2008. “Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector.” Quarterly Journal of Economics, vol. 123(2), pp. 489-530.

Wagner, Joachim, 2007. "Exports and Productivity: A Survey of the Evidence from Firm-level Data." The World Economy, Blackwell Publishing, vol. 30(1), pp 60-82.

**Table 1 – Tabulation of Data: Countries, Sectors, Regions, and Years**

| Country | Freq. | Country | Freq. | Country | Freq. |
|---|---|---|---|---|---|
| Algeria | 201 | Ghana | 267 | Nicaragua | 624 |
| Angola | 131 | Guatemala | 589 | Niger | 46 |
| Argentina | 396 | Guinea | 49 | Oman | 49 |
| Bangladesh | 967 | Guinea Bissau | 28 | Pakistan | 890 |
| Belarus | 53 | Guyana | 152 | Panama | 106 |
| Bolivia | 226 | Honduras | 506 | Paraguay | 149 |
| Botswana | 49 | India | 2,729 | Peru | 244 |
| Brazil | 1,399 | Indonesia | 460 | Philippines | 628 |
| Burkina Faso | 23 | Jamaica | 40 | Poland | 66 |
| Burundi | 52 | Jordan | 271 | Rwanda | 37 |
| Cambodia | 20 | Kyrgyzstan | 85 | Senegal | 215 |
| Cameroon | 90 | Laos | 123 | South Africa | 1,126 |
| Cape Verde | 41 | Lebanon | 70 | Sri Lanka | 396 |
| Chile | 1,158 | Lesotho | 20 | Swaziland | 32 |
| China | 1,554 | Lithuania | 116 | Syria | 48 |
| Colombia | 536 | Madagascar | 136 | Tajikistan | 128 |
| Costa Rica | 277 | Malawi | 151 | Tanzania | 315 |
| DRC | 85 | Malaysia | 697 | Thailand | 1,166 |
| Dominican Rep. | 107 | Mauritania | 47 | Turkey | 1,094 |
| Ecuador | 474 | Mauritius | 117 | Uganda | 152 |
| Egypt | 725 | Mexico | 799 | Ukraine | 207 |
| El Salvador | 556 | Moldova | 53 | Uruguay | 175 |
| Eritrea | 25 | Mongolia | 156 | Uzbekistan | 201 |
| Ethiopia | 364 | Morocco | 832 | Vietnam | 1,123 |
| Gambia | 16 | Mozambique | 274 | Zambia | 154 |
| Georgia | 75 | Namibia | 60 | **Total** | **27,798** |

| Sector | Freq. |
|---|---|
| Textiles | 2,911 |
| Leather | 750 |
| Garments | 4,712 |
| Food | 5,646 |
| Metals & machinery | 3,208 |
| Electronics | 1,932 |
| Chemicals & pharma | 2,611 |
| Wood & furniture | 1,555 |
| Non-metallic & plastic | 1,896 |
| Other manufacturing | 2,577 |

| Region | Freq. |
|---|---|
| Africa | 4,303 |
| Asia | 10,909 |
| ECA | 2,078 |
| LAC | 8,513 |
| MENA | 1,995 |

| Year | Freq. |
|---|---|
| 2002 | 5,352 |
| 2003 | 6,199 |
| 2004 | 4,300 |
| 2005 | 2,610 |
| 2006 | 6,926 |
| 2007 | 1,407 |
| 2008 | 1,004 |

Source: Own calculations using World Bank's Enterprise Survey Data. In the results that follow, the number of observations in each sample differs according to data availability from the Enterprise Survey. The number of observations in this table reflects data availability on exporting behavior and ATFP.

**Table 2 – Summary Statistics**

| Variable | Observations | Mean | Std. Deviation | Min | Max |
|---|---|---|---|---|---|
| exporter (d) | 46765 | 0.36213 | 0.480621 | 0 | 1 |
| ln_(1+exports/sales) | 46765 | 1.263318 | 1.810359 | 0 | 4.61512 |
| ATFP | 28173 | 9.466101 | 2.29765 | -6.92763 | 22.44495 |
| ln_size | 46444 | 3.630385 | 1.545063 | 0 | 9.944774 |
| ln_age | 45944 | 2.559312 | 0.878591 | 0 | 6.909753 |
| foreign (d) | 46866 | 0.09493 | 0.293122 | 0 | 1 |
| public (d) | 46640 | 0.031582 | 0.174887 | 0 | 1 |
| union (d) | 33246 | 0.25934 | 0.438279 | 0 | 1 |
| training (d) | 45054 | 0.42489 | 0.494332 | 0 | 1 |
| auditor (d) | 45681 | 0.554892 | 0.496983 | 0 | 1 |
| techlic (d) | 27693 | 0.137002 | 0.343856 | 0 | 1 |
| iso (d) | 42570 | 0.206906 | 0.405093 | 0 | 1 |
| email (d) | 45055 | 0.635534 | 0.481285 | 0 | 1 |
| web (d) | 43519 | 0.402928 | 0.490492 | 0 | 1 |

Source: Own calculations using World Bank's Enterprise Survey Data. (d) – dummy variable.

**Table 3 - Exporter Premium**

| Not controlling for size | | | | |
|---|---|---|---|---|
| | exporter (β) | exporter (%) | Observations | R-squared |
| size | 1.049*** | 185% | 45817 | 0.23 |
| sales /worker | 0.490*** | 63% | 39877 | 0.76 |
| value added | 0.478*** | 61% | 26697 | 0.74 |
| ATFP | 0.445*** | 56% | 27798 | 0.61 |
| ATFP2 | 0.504*** | 66% | 27798 | 0.73 |
| capital/worker | 0.227** | 25% | 28201 | 0.58 |
| avg. prod. wage | 0.159*** | 17% | 23363 | 0.93 |
| avg. non-prod. wage | 0.171*** | 19% | 17125 | 0.95 |
| | | | | |
| **Controlling for size** | | | | |
| | exporter (β) | exporter (%) | Observations | R-squared |
| sales /worker | 0.289*** | 34% | 39877 | 0.77 |
| value added | 0.316*** | 37% | 26697 | 0.75 |
| ATFP | 0.269*** | 31% | 27798 | 0.62 |
| ATFP2 | 0.322*** | 38% | 27798 | 0.74 |
| capital/worker | 0.195* | 22% | 28201 | 0.58 |
| avg. prod. wage | 0.041 | 4% | 23150 | 0.93 |
| avg. non-prod. wage | 0.060* | 6% | 16929 | 0.95 |

Top panel is given by $\ln X_i = \alpha + \beta * Export_i + Sector + Country + Year + \varepsilon_i$
$X_i$ includes size, total sales per worker, value added per worker, ATFP, capital per worker, average production wage, and average non-production wage, and. In the bottom panel I include *Size* as an explanatory variable. The difference in percentage terms between exporters and non-exporters is calculated using Halvorsen and Palmquist (1980) method: 100*(exp(β)-1).

**Table 4 - Productivity Premia, Signaling Tools, and Technological Tools**

| **Panel 1 - Productivity and foreign-owned technological license** | | | | |
|---|---|---|---|---|
| | sales/worker | value added | ATFP | ATFP2 |
| exporter x techlic | -0.338** | -0.333* | -0.360** | -0.435*** |
| | 0.154 | 0.17 | 0.168 | 0.168 |
| exporter (d) | 0.353*** | 0.345*** | 0.303*** | 0.360*** |
| | 0.062 | 0.066 | 0.065 | 0.065 |
| techlic (d) | 0.438*** | 0.498*** | 0.290** | 0.410*** |
| | 0.109 | 0.122 | 0.113 | 0.119 |
| Observations | 24520 | 16157 | 18974 | 18974 |
| R-squared | 0.75 | 0.75 | 0.6 | 0.73 |
| | | | | |
| **Panel 2 - Productivity and ISO certification** | | | | |
| | sales/worker | value added | ATFP | ATFP2 |
| exporter x ISO | -0.094** | -0.133* | -0.184* | -0.188* |
| | 0.113 | 0.116 | 0.115 | 0.113 |
| exporter (d) | 0.292*** | 0.302*** | 0.298*** | 0.341*** |
| | 0.062 | 0.069 | 0.068 | 0.070 |
| ISO (d) | 0.305*** | 0.388*** | 0.284*** | 0.347*** |
| | 0.090 | 0.083 | 0.081 | 0.080 |
| Observations | 35135 | 23179 | 23882 | 23882 |
| R-squared | 0.77 | 0.75 | 0.62 | 0.75 |
| | | | | |
| **Panel 3 - Productivity and external financial auditor** | | | | |
| | sales/worker | value added | ATFP | ATFP2 |
| exporter x auditor | 0.03 | -0.007 | -0.02 | 0.03 |
| | 0.102 | 0.113 | 0.114 | 0.116 |
| exporter (d) | 0.268*** | 0.316*** | 0.276*** | 0.296*** |
| | 0.087 | 0.095 | 0.095 | 0.100 |
| auditor (d) | 0.230*** | 0.161** | 0.238*** | 0.220*** |
| | 0.07 | 0.07 | 0.071 | 0.074 |
| Observations | 38080 | 25083 | 26212 | 26212 |
| R-squared | 0.77 | 0.75 | 0.62 | 0.75 |

Robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable is the measure of productivity at the top of each column. The following is estimated for each signaling and technological tool:

$$\ln X_i = \alpha + \beta_1 Export_i + \beta_2 Export_i * Tool + \upsilon Tool + \delta Size + d_j + d_c + d_t + \varepsilon_i$$

**Table 4 Continued-**
**Productivity Premia, Signaling Tools, and Technological Tools**

| **Panel 4 - Productivity and use of email** | | | | |
|---|---|---|---|---|
| | sales/worker | value added | ATFP | ATFP2 |
| exporter x email | -0.142 | -0.059 | 0.001 | -0.026 |
| | 0.144 | 0.167 | 0.128 | 0.152 |
| exporter (d) | 0.362*** | 0.321** | 0.221* | 0.287** |
| | 0.134 | 0.161 | 0.116 | 0.144 |
| email (d) | 0.577*** | 0.496*** | 0.426*** | 0.511*** |
| | 0.072 | 0.070 | 0.072 | 0.072 |
| Observations | 37553 | 25551 | 25743 | 25743 |
| R-squared | 0.77 | 0.75 | 0.63 | 0.75 |
| | | | | |
| | sales/worker | value added | ATFP | ATFP2 |
| exporter x website | -0.091* | -0.09* | -0.001 | -0.01 |
| | 0.1 | 0.105 | 0.106 | 0.105 |
| exporter (d) | 0.288*** | 0.313*** | 0.206** | 0.263*** |
| | 0.076 | 0.084 | 0.081 | 0.084 |
| website (d) | 0.384*** | 0.302*** | 0.321*** | 0.319*** |
| | 0.064 | 0.065 | 0.068 | 0.067 |
| Observations | 36671 | 24741 | 25729 | 25729 |
| R-squared | 0.78 | 0.77 | 0.63 | 0.75 |

Robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable is the measure of productivity at the top of each column. The following is estimated for each signaling and technological tool:

$$\ln X_i = \alpha + \beta_1 Export_i + \beta_2 Export_i * Tool + \upsilon Tool + \delta Size + d_j + d_c + d_t + \varepsilon_i$$

**Table 5 - Stage 1. Effect of Tools on Productivity**

| | Dependent variable is ATFP | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| size | 0.208*** | 0.137*** | 0.125*** | 0.071*** | 0.064** |
| | 0.022 | 0.035 | 0.039 | 0.024 | 0.027 |
| age | -0.007 | -0.003 | -0.032 | 0.006 | -0.018 |
| | 0.033 | 0.04 | 0.045 | 0.036 | 0.04 |
| foreign (d) | | 0.350*** | 0.190* | 0.306*** | 0.183* |
| | | 0.086 | 0.098 | 0.087 | 0.097 |
| public (d) | | -0.419*** | -0.591*** | -0.331*** | -0.586* |
| | | 0.089 | 0.191 | 0.109 | 0.313 |
| training (d) | | 0.031 | -0.072 | -0.024 | -0.103 |
| | | 0.101 | 0.109 | 0.089 | 0.094 |
| union (d) | | 0.027 | -0.017 | 0.013 | -0.03 |
| | | 0.063 | 0.075 | 0.063 | 0.073 |
| techlic (d) | | | 0.260*** | | 0.202** |
| | | | 0.083 | | 0.081 |
| iso (d) | | | 0.296*** | | 0.238*** |
| | | | 0.068 | | 0.067 |
| auditor (d) | | | 0.218*** | | 0.182*** |
| | | | 0.07 | | 0.062 |
| email (d) | | | | 0.337*** | 0.351*** |
| | | | | 0.103 | 0.113 |
| web (d) | | | | 0.333*** | 0.321*** |
| | | | | 0.063 | 0.075 |
| Constant | 9.648*** | 6.835*** | 11.747*** | 9.266*** | 11.587*** |
| | 0.422 | 0.421 | 0.167 | 0.259 | 0.163 |
| Observations | 26371 | 20792 | 14239 | 19706 | 13692 |
| R-squared | 0.6 | 0.73 | 0.74 | 0.75 | 0.75 |

Robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%. (d) – dummy variable. Dependent variable is the measure of firm productivity, ATFP. All regressions control for sector, country, and year effects.

**Table 6 - Stage 2. Probit Model**

| | Dependent variable - dummy for exporter | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| ATFP Residual | 0.049*** | 0.058*** | 0.051*** | 0.044*** | 0.040*** |
| | 0.01 | 0.012 | 0.015 | 0.011 | 0.014 |
| size | 0.141*** | 0.169*** | 0.147*** | 0.143*** | 0.126*** |
| | 0.01 | 0.014 | 0.018 | 0.013 | 0.016 |
| age | 0.055*** | 0.003 | -0.009 | 0.005 | -0.007 |
| | 0.015 | 0.018 | 0.02 | 0.018 | 0.019 |
| foreign (d) | | 0.218*** | 0.144*** | 0.185*** | 0.129*** |
| | | 0.029 | 0.036 | 0.032 | 0.039 |
| public (d) | | -0.147*** | -0.124*** | -0.157*** | -0.156*** |
| | | 0.024 | 0.043 | 0.025 | 0.051 |
| training (d) | | 0.101*** | 0.075* | 0.090** | 0.068 |
| | | 0.036 | 0.042 | 0.036 | 0.042 |
| union (d) | | -0.004 | 0.003 | 0.01 | 0.023 |
| | | 0.041 | 0.04 | 0.039 | 0.038 |
| techlic (d) | | | 0.057 | | 0.036 |
| | | | 0.051 | | 0.052 |
| iso (d) | | | 0.215*** | | 0.218*** |
| | | | 0.037 | | 0.037 |
| auditor (d) | | | 0.057 | | 0.03 |
| | | | 0.048 | | 0.045 |
| email (d) | | | | 0.119*** | 0.094* |
| | | | | 0.038 | 0.048 |
| web (d) | | | | 0.119*** | 0.110** |
| | | | | 0.043 | 0.049 |
| Observations | 25873 | 20509 | 14076 | 19487 | 13532 |
| Pseudo R-squared | 0.23 | 0.28 | 0.29 | 0.3 | 0.31 |

Robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%. (d) – dummy variable. Dependent variable =1 if the firm is an exporter and 0 otherwise. Coefficients show marginal effects. All regressions control for sector, country, and year effects.

**Table 7 - Stage 2. Tobit Model**

| | Dependent variable - ln(1+proportion of sales from exports) | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| ATFP Residual | 0.116*** | 0.124*** | 0.101*** | 0.091*** | 0.075** |
| | 0.023 | 0.026 | 0.029 | 0.024 | 0.026 |
| size | 0.328*** | 0.368*** | 0.290*** | 0.308*** | 0.245*** |
| | 0.019 | 0.025 | 0.029 | 0.024 | 0.028 |
| age | 0.104** | -0.034 | -0.058 | -0.028 | -0.050 |
| | 0.034 | 0.041 | 0.041 | 0.04 | 0.04 |
| foreign (d) | | 0.530*** | 0.358*** | 0.449*** | 0.331*** |
| | | 0.067 | 0.075 | 0.071 | 0.079 |
| public (d) | | -0.334*** | -0.217* | -0.353*** | -0.26 |
| | | 0.059 | 0.106 | 0.066 | 0.155 |
| training (d) | | 0.243** | 0.166 | 0.217** | 0.154 |
| | | 0.081 | 0.088 | 0.081 | 0.086 |
| union (d) | | 0.001 | 0.0294 | 0.0213 | 0.056 |
| | | 0.083 | 0.09 | 0.081 | 0.087 |
| techlic (d) | | | 0.109 | | 0.080 |
| | | | 0.093 | | 0.097 |
| iso (d) | | | 0.417*** | | 0.412*** |
| | | | 0.075 | | 0.078 |
| auditor (d) | | | 0.127 | | 0.068 |
| | | | 0.081 | | 0.079 |
| email (d) | | | | 0.393*** | 0.315** |
| | | | | 0.092 | 0.111 |
| web (d) | | | | 0.202* | 0.174 |
| | | | | 0.096 | 0.105 |
| Observations | 26004 | 20627 | 14193 | 19604 | 13648 |
| chi2 | 2737.6 | 1982.4 | 1567.3 | 2080.7 | 1555.5 |

Robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%.
(d) – dummy variable. Dependent variable is ln(1+proportion of sales from exports).
Coefficients show the changes in the conditional expected value of the observed dependent variable $\partial E(y_i^* \mid a < y_i^*) / \partial x_i$ . All regressions control for sector, country, and year effects.

**Table 8 – Robustness Check 1 -*ATFP vs. ATFP2***
**Estimates Using ATFP2 (s=1/10)**

| | First Stage | Second Stage | |
|---|---|---|---|
| | ATFP2 | probit | tobit-conditional |
| ATFP2 residual | | 0.037*** | 0.074** |
| | | 0.013 | 0.026 |
| size | 0.051** | 0.126*** | 0.245*** |
| | 0.026 | 0.016 | 0.028 |
| age | 0 | -0.006 | -0.049 |
| | 0.039 | 0.019 | 0.04 |
| foreign (d) | 0.260*** | 0.129*** | 0.329*** |
| | 0.097 | 0.039 | 0.078 |
| public (d) | -0.53 | -0.156*** | -0.258 |
| | 0.371 | 0.052 | 0.157 |
| training (d) | -0.114 | 0.068 | 0.153 |
| | 0.097 | 0.042 | 0.086 |
| union (d) | -0.031 | 0.022 | 0.054 |
| | 0.063 | 0.045 | 0.087 |
| techlic (d) | 0.229*** | 0.037 | 0.079 |
| | 0.066 | 0.051 | 0.096 |
| ISO (d) | 0.294*** | 0.218*** | 0.413*** |
| | 0.06 | 0.038 | 0.077 |
| auditor (d) | 0.217*** | 0.03 | 0.067 |
| | 0.06 | 0.039 | 0.079 |
| email (d) | 0.500*** | 0.093* | 0.315** |
| | 0.118 | 0.049 | 0.112 |
| website (d) | 0.301*** | 0.110** | 0.174* |
| | 0.069 | 0.05 | 0.106 |
| Observations | 13692 | 13532 | 13648 |
| R-squared / Pseudo R2 / Chi2 | 0.84 | 0.31 | 1560.08 |

Robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%. (d) – dummy variable. ATFP2 column – the dependent variable is ATFP2. Probit column – the dependent variable is a dummy =1 if the firm exports and is 0 otherwise. For the tobit estimates, the dependent variable is ln(1+proportion of sales from exports). Coefficients show marginal effects. All regressions control for sector, country, and year effects.

**Table 9 - Robustness Check 2 -** *Labor productivity vs. ATFP*
**Estimates Using Sales Per Worker vs. ATFP**

| | First Stage | Second Stage | |
|---|---|---|---|
| | sales/worker | probit | tobit-conditional |
| sales/worker residual | | 0.034*** | 0.073** |
| | | 0.011 | 0.024 |
| size | 0.055** | 0.113*** | 0.241*** |
| | 0.026 | 0.014 | 0.026 |
| age | 0.037 | -0.005 | -0.032 |
| | 0.032 | 0.017 | 0.036 |
| foreign (d) | 0.375*** | 0.100*** | 0.334*** |
| | 0.083 | 0.038 | 0.085 |
| public (d) | -0.319 | 0.028 | 0.25 |
| | 0.277 | 0.144 | 0.421 |
| training (d) | -0.041 | 0.063* | 0.148 |
| | 0.088 | 0.034 | 0.076 |
| union (d) | -0.022 | 0.03 | 0.053 |
| | 0.061 | 0.036 | 0.079 |
| techlic (d) | 0.242*** | 0.003 | 0.019 |
| | 0.065 | 0.041 | 0.083 |
| ISO (d) | 0.205** | 0.204*** | 0.409*** |
| | 0.09 | 0.036 | 0.076 |
| auditor (d) | 0.233*** | 0.043 | 0.109 |
| | 0.062 | 0.033 | 0.07 |
| email (d) | 0.553*** | 0.083** | 0.280** |
| | 0.101 | 0.037 | 0.092 |
| website (d) | 0.196*** | 0.112*** | 0.223* |
| | 0.066 | 0.041 | 0.091 |
| Observations | 18061 | 17974 | 17974 |
| R-squared / Pseudo R2 / Chi2 | 0.85 | 0.29 | 1588.67 |

Robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%. (d) – dummy variable. Sales/worker column – the dependent variable is sales per worker. Probit column – the dependent variable is a dummy =1 if the firm exports and is 0 otherwise. For the tobit estimate, the dependent variable is ln(1+proportion of sales from exports). Coefficients show marginal effects. All regressions control for sector, country, and year effects.

**Table 10 - Robustness Check 3** – *One stage regressions*

| | One stage regressions | |
|---|---|---|
| | probit | tobit-conditional |
| ATFP | 0.040*** | 0.075** |
| | 0.014 | 0.027 |
| size | 0.124*** | 0.240*** |
| | 0.016 | 0.028 |
| age | -0.006 | -0.048 |
| | 0.019 | 0.04 |
| foreign (d) | 0.121*** | 0.314*** |
| | 0.039 | 0.079 |
| public (d) | -0.141** | -0.224 |
| | 0.055 | 0.161 |
| training (d) | 0.072* | 0.161 |
| | 0.042 | 0.086 |
| union (d) | 0.024 | 0.058 |
| | 0.045 | 0.087 |
| techlic (d) | 0.028 | 0.064 |
| | 0.051 | 0.096 |
| iso (d) | 0.207*** | 0.391*** |
| | 0.038 | 0.079 |
| auditor (d) | 0.023 | 0.054 |
| | 0.039 | 0.08 |
| email (d) | 0.081 | 0.292* |
| | 0.05 | 0.114 |
| web (d) | 0.097** | 0.149 |
| | 0.048 | 0.102 |
| Observations | 13532 | 13648 |
| Pseudo R-squared / Chi2 | 0.31 | 1555.5 |

Robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%. (d) – dummy variable. Probit column – the dependent variable is a dummy =1 if the firm exports and is 0 otherwise. For the tobit estimate, the dependent variable is ln(1+proportion of sales from exports). Coefficients show marginal effects. All regressions control for sector, country, and year effects.